Kankichi SOHMA*: A study on the pollen grains of *Lythrum salicaria* and *L. anceps***

相馬寛吉*: エゾミソハギとミソハギの花粉形態**

Lythrum, a genus including approximately 35 species, is confined chiefly to the tropics and temperate areas of the Old World. In Japan, only two species have been known, i.e. *L. salicaria* L. and *L. anceps* (Kochne) Makino. *L. anceps*, in contrast to the widely distributed species *L. salicaria*, is endemic to Japan and Korea and differs primarily from the latter species in having glabrescent stems, acute to broadly cuneate leaf base and sessile but not clasping leaves. Pollen-morphological data on *L. anceps* are scant and represented only by light microscopic observations (Ikuse 1956; Shimakura 1973). On the othier hand, there is a number of pollen studies on *L. salicaria.* A comprehensive bibliography of the pollen morphology of the species is included in Hulshof & Manten (1971) and Thanikaimoni (1972, 1973, 1976).

In this paper the author indicates that, besides the external morphological characters, other significant and distinctive characters between *L. salicaria* and *L. anceps* are found in the pollen grains. It also shows that the indication may be reliable for identifying fossil grains.

Materials and Methods Pollen samples were removed from herbarium specimens deposited at the Biological Institute (TUS) and the Botanical Garden (TUSG) of the Tôhoku University, Sendai.

The method of preparation for scanning electron microscopic observation, which involves expansion of grains, cleaning of extraneous material from the exine surfaces, stabilization through critical point drying and mounting, was followed according to the procedures outlined by Lynch & Webster (1975). A Hitachi-Akashi MSM-101 scanning electron microscope was used.

For light microscopy, the pollen residues were acetolyzed (Faegri & Iversen 1964) and mounted in 2000 cs silicone oil. A complete set of permanent slides is filed at the Biological Institute, Tôhoku University, Sendai.

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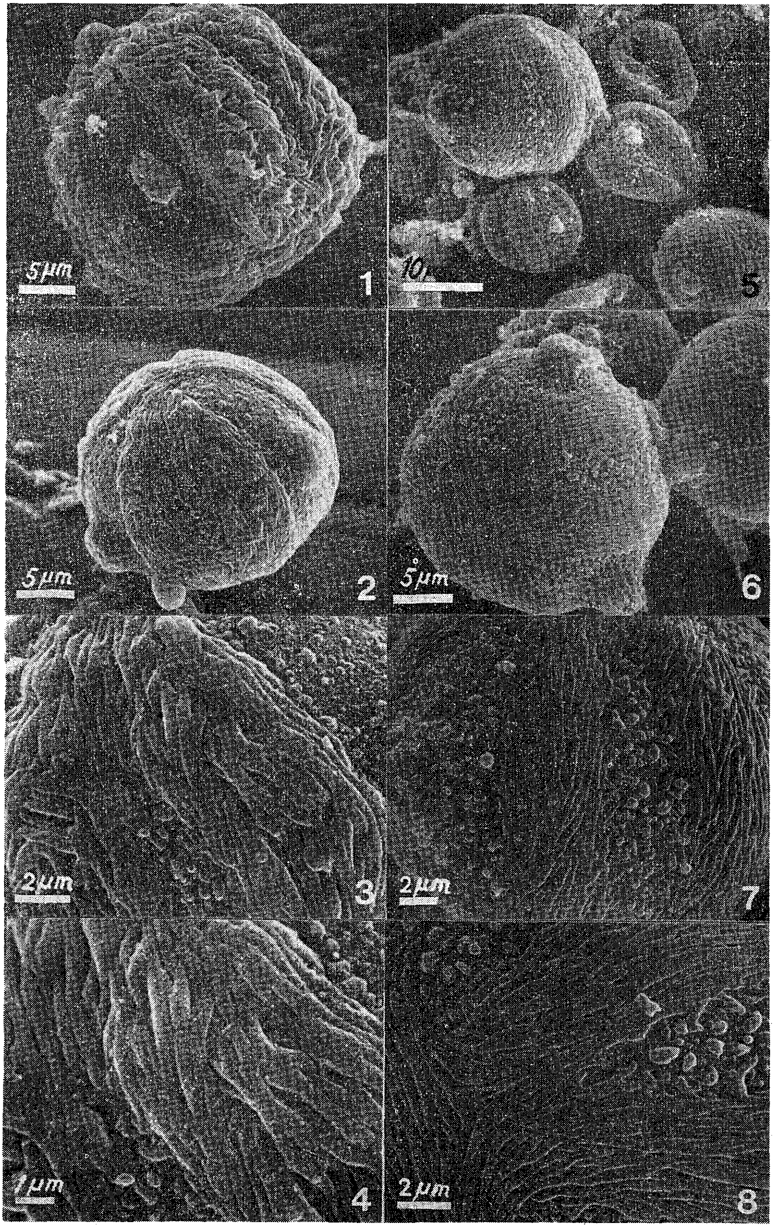

5 μm
1
10
5
5 μm
2
5 μm
6
2 μm
3
2 μm
7
1 μm
4
2 μm
8

Results Pollen grains of both *L. salicaria.* and *L. anceps* (Figs. 1-8) are heterocolpate with a pseudocolpus formed as meridional grooves between the ordinary colpi possessing a germinal pore at the equator, radially symmetrical, isopolar, tectate, oblate spheroidal to suboblate in equatorial view, and generally rounded hexagonal in polar view. In *L. salicaria*, some grains have circular to subprolate outline in equatorial view. The colpus without an equatorical constriction is extending in poleward directions with tapering ends. The surface of the colpus is sparsely covered with ektexinous granules of various sizes less than 0.5 μm in diameter. The pseudocolpus is slightly narrower and shorter than the ordinary colpus, and the surface possesses ektexinous granules identical with those on the ordinary colpus. *L. salicaria* has pollen with a narrower and shorter pseudocolpus than in *L. anceps*. The pore is more or less circular in a diameter of about 3-6 μm and sometimes protruding. The exine is striate. The lirae, narrow ridges between the striae, are generally round-ridged with a width of less than 0.5 μm, closely associated with 10-15 per intercolpium (the area delimited by two adjacent colpi), elongated, straight or curved, interweaved or anastomosed and often branched. The irregularity of arrangement of the lirae is much stressed in *L. salicaria* than in *L. anceps*. On the lirae, minute supratectal processes (ca. 0. 1 μm) are common in *L. salicaria*, but they are not found in *L. anceps*.

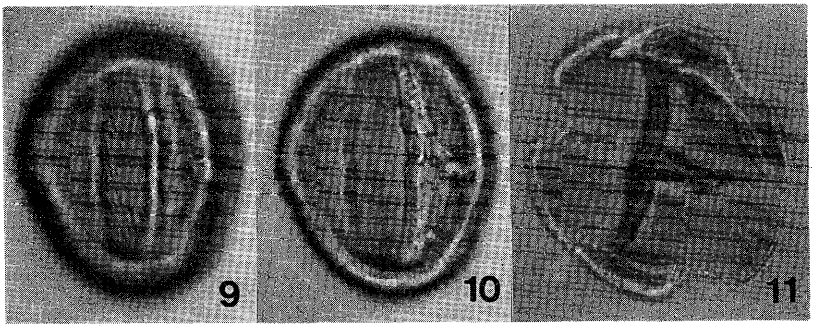
The size of pollen grains for both species varies widely, 18-32 × 15-20 μm with the mean of 22 × 21 μm in *L. salicaria* and 12-29 × 17-30 μm with the mean of 18 × 20 μm in *L. anceps*. The samllest examined were those of *L. anceps* with a polar axis of 12 μm and the largest those of *L. salicaria* which had a length of 32 μm. Fig. 5 demonstrates that there is a considerable variation in grain size in *L. anceps*.

Figs. 1-8. 1-4: *Lythrum salicaria* L. — Nemuro, Hokkaidô, Kikuchi et al. s.n., Aug. 21, 1969, TUSG. 1: Pollen grain in slightly oblique equatorial position with one colpus possessing a pore in the equator and one pseudocolpus in the right hand. The grain has much pronounced irregular striation on the exine. 2: The grain with a narrower and shorter pseudocolpus between the ordinary colpi in face view. The pores are protruded. 3: Detail showing the interweaved striation and the granules both on the ordinary colpus and the pseudocolpus. 4: Detail showing the lirae with the minute supratectal processes 5-8: *Lythrum anceps* (Koehne) Makino—Sendai, Aug. 10, 1977, Sohma 3065, TUS. 5: The pollen grains showing a wide range of variation in size. 6: Pollen grain in oblique equatorial position with a pseudocolpus between the ordinary colpi. The pores are protruded. 7: The grain with a pseudocolpus in face view and the ordinary colpus possessing a pore at the left side. There are the granules on the surface of them. The exine has striation. 8: Detail showing the lirae of the striation.

Discussion As can be seen from the descriptions and illustrations, the pollen of *Lythrum salicaria* is virtually distinguishable from that of *L. anceps* mainly in the narrow pseudocolpus, in the irregular arrangement and the minute supratectal processes of the lirae. The morphological difference in pollen between two species is striking, especially when one considers the fact that both of these species are insect pollinated. Pollen transport may be effected by butterflies, moths, bees, beetles and flies. It is appropriate to question at this point whether different exine patterns reflect adaptation to different pollen dispersal mechanisms. The data presented here do not substantiate such a relationship.

L. salicaria, a heterostylous species, is known to form three types of pollen grains, large, medium and small ones (Tischler 1917). Bodmer (1927) and Schoch-Bodmer (1937, 1938) have shown that there is within each of the three types of the pollen a wide range of variation and even a transgression of pollen sizes between the minima of the large pollen type and the maxima of the medium type, the same being true for medium and small pollen. The condition of these features is considered to be similar to the pollen of *L. anceps*.

It was S. Tsuji of the Institute of Applied Earth Science, Nihon University, who recovered a pollen type that has been considered to relate the genus



Figs. 9-11. Light micrographs of fossil pollen referable to that of *Lythrum anceps* from the Holocene deposits, all ×1000. 9-10: Grains in equatorial view, high focus and lower focus. Iida-gawa, Hachirôgata, Akita (Slide, Tsuji-AT-1-90). 11: Grain in polar view. Kuzunori, Honjô, Akita (Slide, Tsuji-no. 467-HJ-1-30).

Lythrum from the Holocene deposits near Hachirô-gata and Kuzumori near Shinjô, Akita Prefecture, Japan, respectively. The calculated date of these deposits is estimated to fall between 1000-2000 y. B. P. (Tsuji, personal communication, Aug. 1978). Tsuji has kindly provided the present author with a set of single-grain preparations containing the fossil grains referred to *Lythrum* for a re-examination into the relationship to extant species of the genus. The morphological characters of the fossil grains bear a striking resemblance to those of the extant *L. anceps*. The fossil grains (Figs. 9-11) are heterocolpate with a pseudocolpus between the ordinary colpi having a germinal pore at the equator, radially symmetrical, isopolar, tectate, subprolate in equatorial view, and rounded hexagonal in polar view. The colpus without an equatorial constriction has tapering ends. The surface of the colpus appears to be covered with minute granules. The pseudocolpus is slightly narrower and shorter than the ordinary colpus. The pore is circular in a diameter of about 5 μm. The exine is striate. The lirae are closely associated with 10-15 per intercolpium, elongated, more or less parallel, and often branched. The size is 32-40 μm in the polar axis and 27-35 μm in the equatorial diameter (embedding medium glycerine jelly).

These characters of the fossil grains are the most comparable to those of *L. anceps*, the species presently common in wet places in lowlands of Japan. During the time when the lowland deposits were laid down, the vegetation can be characterized in the following way based on the dominancy of the associated fossil grains examined. There occurred a tree vegetation with *Alnus*, *Cryptomeria* and more seldom *Quercus* and *Fagus*, a shrub vegetation with *Ilex* and *Rhamnus*, and a herbaceous vegetation with *Artemisia*, *Lythrum anceps*, Cyperaceae, Gramineae, etc. As a whole it was a mosaic vegetation under a cool temperate climatic condition with the forests in places and open areas covered with a marshy vegetation.

Tsuji & Hibino (1975), and Tsuji & Suzuki (1977) have reported pollen of the Lythraceae from the Holocene deposits in Megata, Akita Prefecture, and Higata-machi, Chiba Prefecture, respectively. At present the specific affinities of the grains are not known, however, they may be probable to be the pollen type of the genus *Lythrum*.

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エゾミソハギとミソハギの花粉を記載した。前者の花粉は後者のそれと比較すると，偽発芽溝 (pseudocolpus) が短かく，指紋状の外膜模様はより不規則で，その隆起線 (lira) 上に微細な突起があることで区別出来る。これに基づき秋田県の完新世堆積物から発見された同属の化石花粉はミソハギのものと同定した。